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(54) **CLOAKING SYSTEM WITH WAVEGUIDES**

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G02B 6/34 (2006.01)

(52) **U.S. Cl.**
CPC ... ***G02B 6/34*** (2013.01); ***F41H 3/02*** (2013.01)

(58) **Field of Classification Search**
CPC F41H 3/02
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,253,639	B2	8/2012	Cohen	
2002/0090131	A1	7/2002	Alden	
2008/0024792	A1	1/2008	Pendry et al.	
2009/0231682	A1	9/2009	Kashyap et al.	
2010/0110559	A1	5/2010	Cai et al.	
2010/0156556	A1	6/2010	Cohen	
2011/0188805	A1*	8/2011	Fu et al.	385/37

FOREIGN PATENT DOCUMENTS

CN	202614973	U	12/2012
WO	2014098984	A1	6/2014

OTHER PUBLICATIONS

International Search Report and Written Opinion received for PCT Application No. PCT/US2013/046602, mailed on Sep. 25, 2013, 11 pages.

Valentine et al., "An Optical Cloak made of Dielectrics", Nature Materials, vol. 8, Apr. 29, 2009, pp. 568-571.

Office Action received for Chinese Patent Application No. 201380004614.0, mailed on Apr. 3, 2015, 5 pages of Chinese Office Action only.

Office Action received for Taiwan Patent Application No. 102143017, mailed on Aug. 20, 2015, 6 pages of English Translation and 4 pages of Taiwan Office Action.

International Preliminary Report on Patentability and Written Opinion Received for PCT Patent Application No. PCT/US2013/046602, mailed on Jul. 2, 2015, 8 pages.

* cited by examiner

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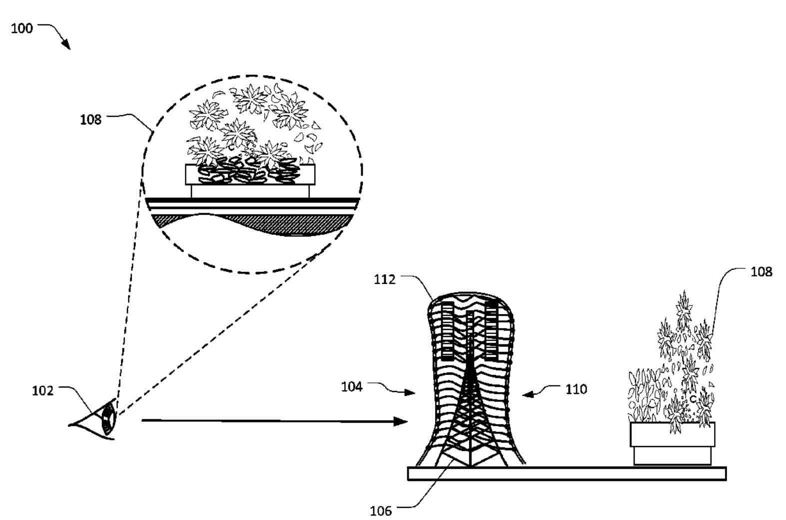
(57) **ABSTRACT**

Described herein are technologies related to passive or active cloaking devices. More particularly, the passive or active cloaking devices utilize input/output grating couplers and waveguides to create an impression of invisibility on an object that is covered by the passive or active cloaking devices.

17 Claims, 7 Drawing Sheets



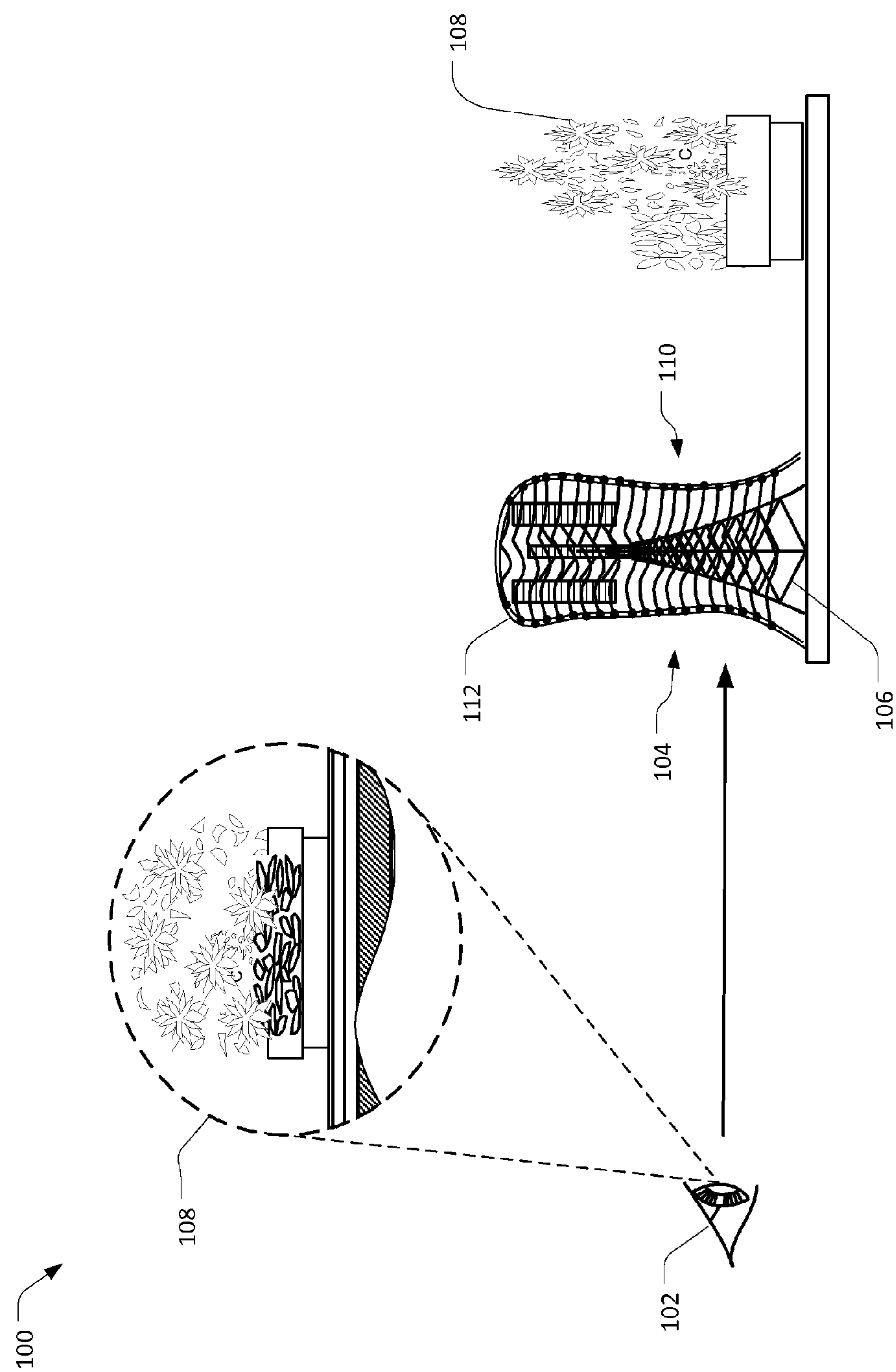


FIG. 1

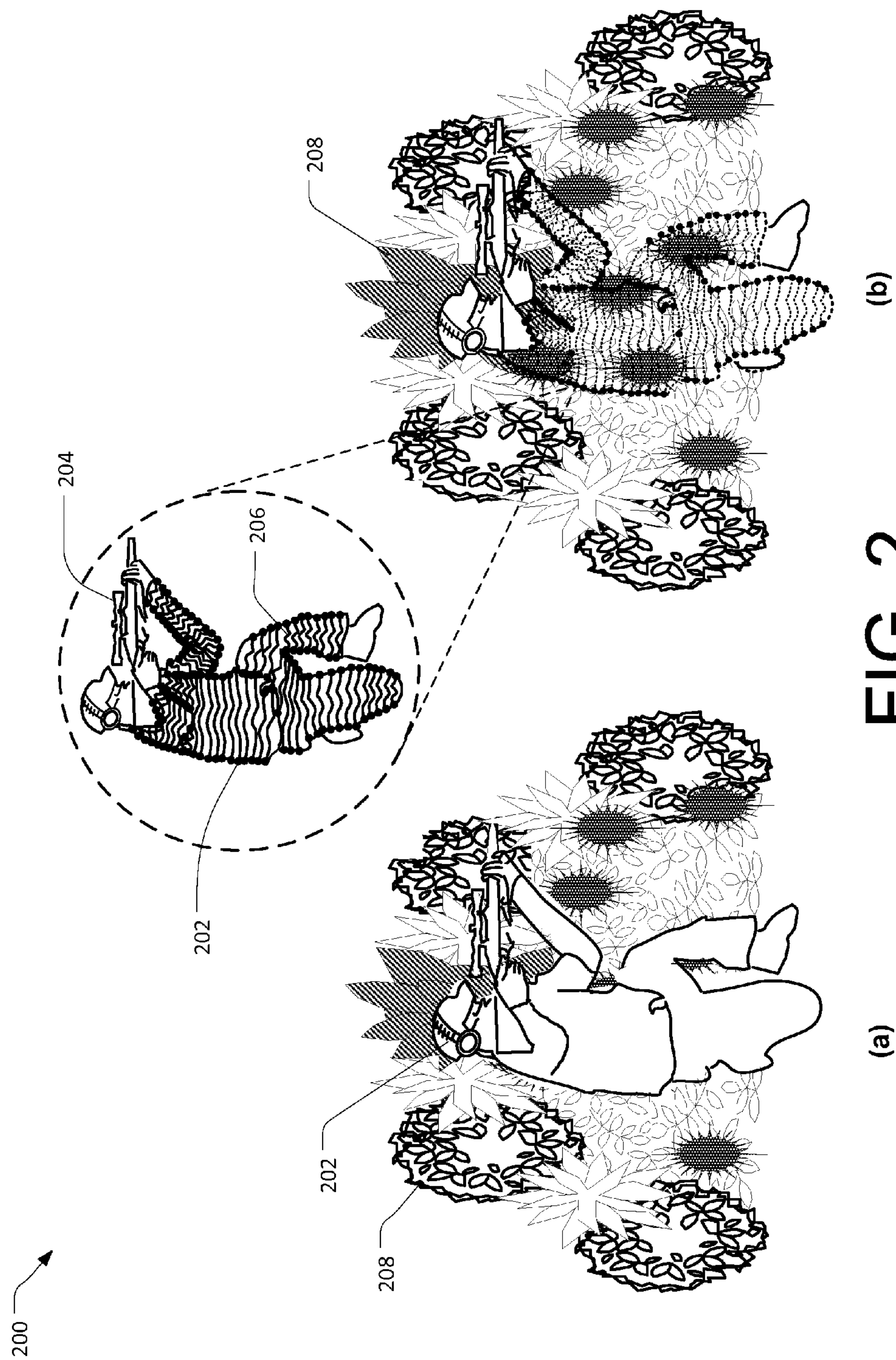


FIG. 2

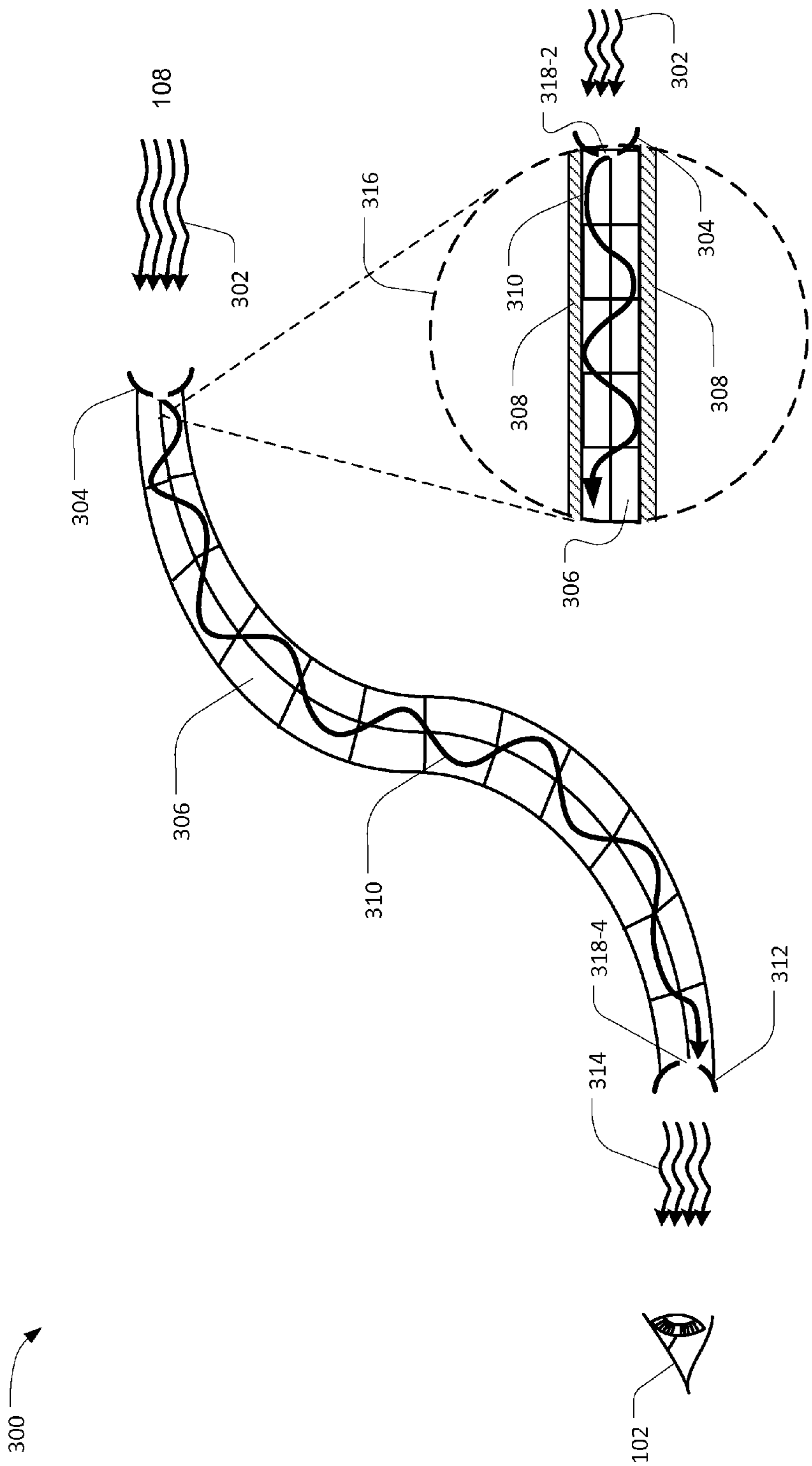

108
302
304
316
318-2
302
310
308
308
304
304
306
306
310
318-4
312
314
102
300

FIG. 3

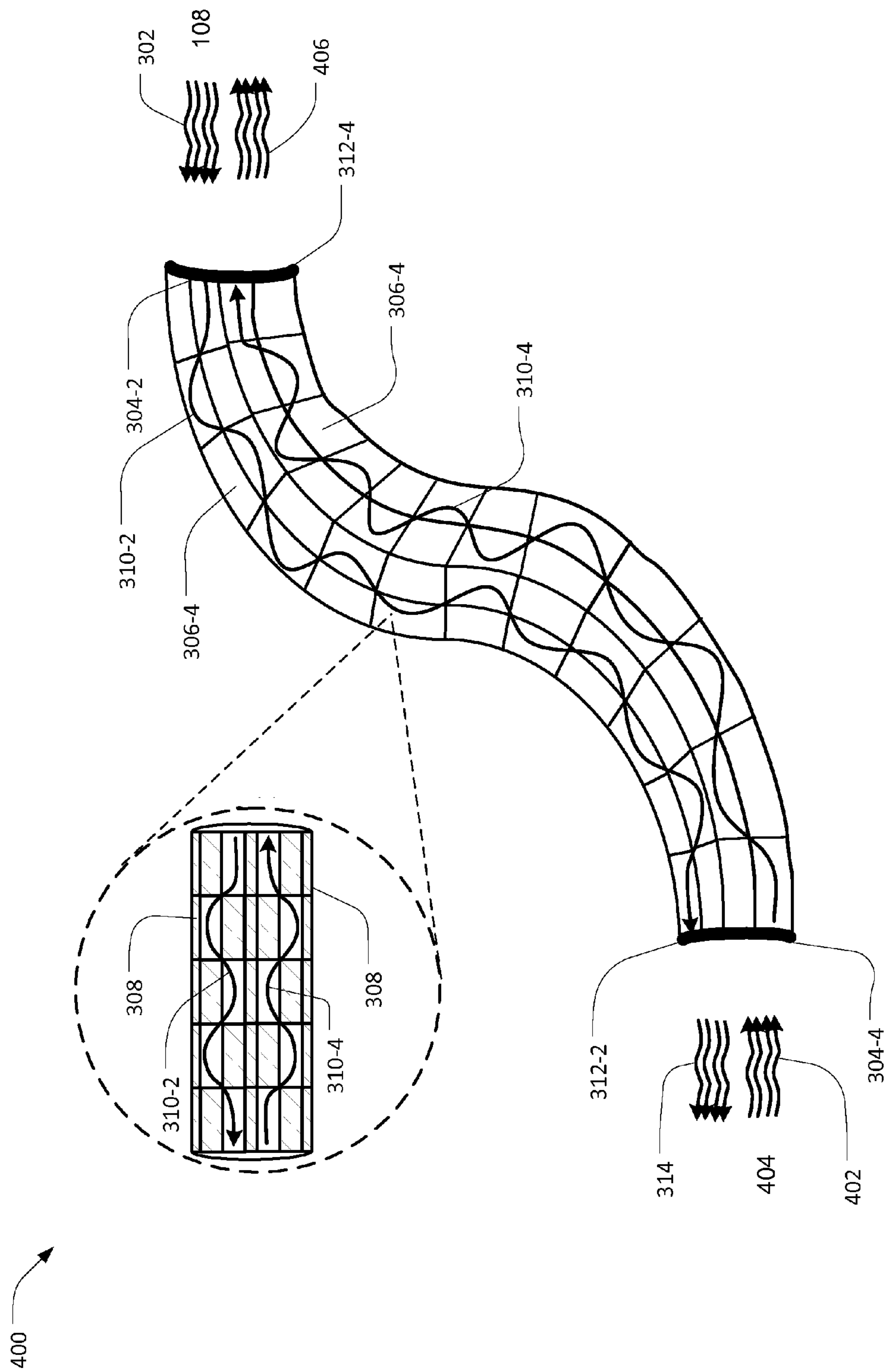
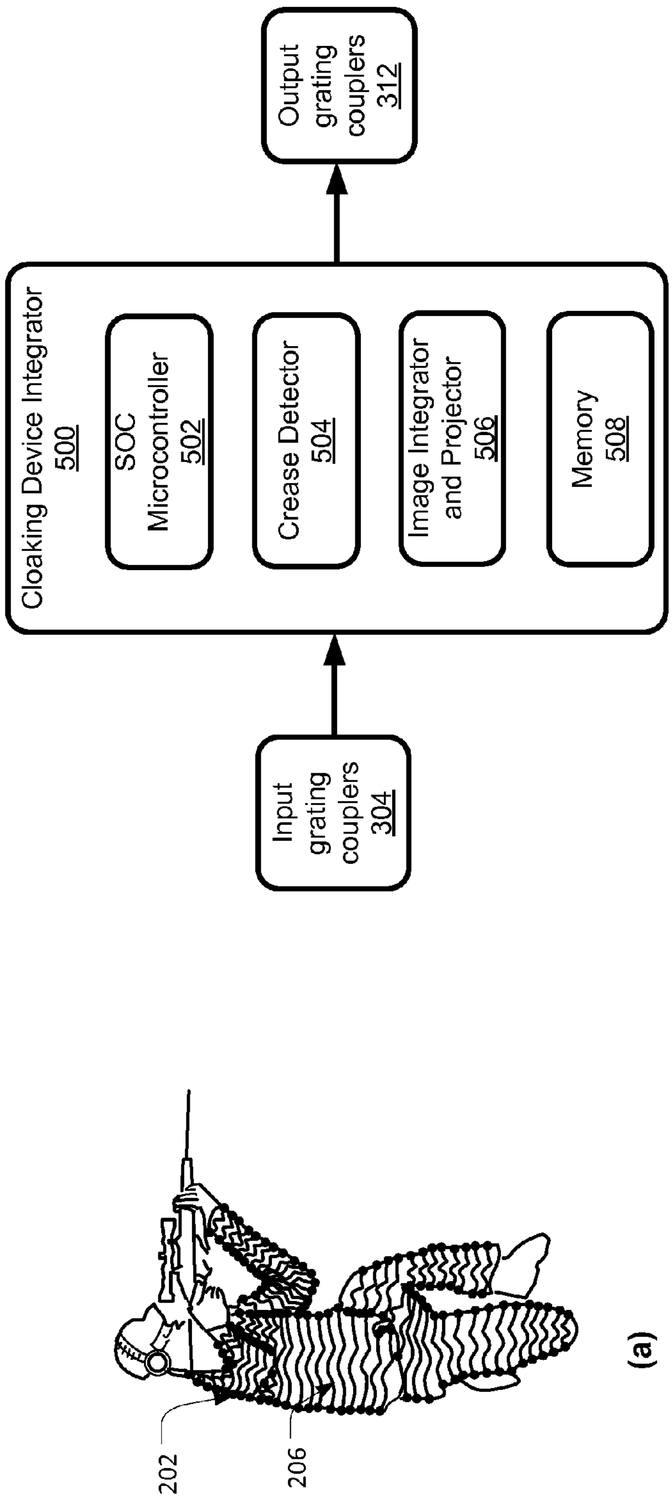

302
108
406
312-4
306-4
310-4
304-2
310-2
306-4
308
308
310-2
310-4
312-2
304-4
314
404
402
400

FIG. 4


202
206
Input grating couplers 304
Cloaking Device Integrator 500
SOC Microcontroller 502
Crease Detector 504
Image Integrator and Projector 506
Memory 508
Output grating couplers 312

(a)

(b)

FIG. 5

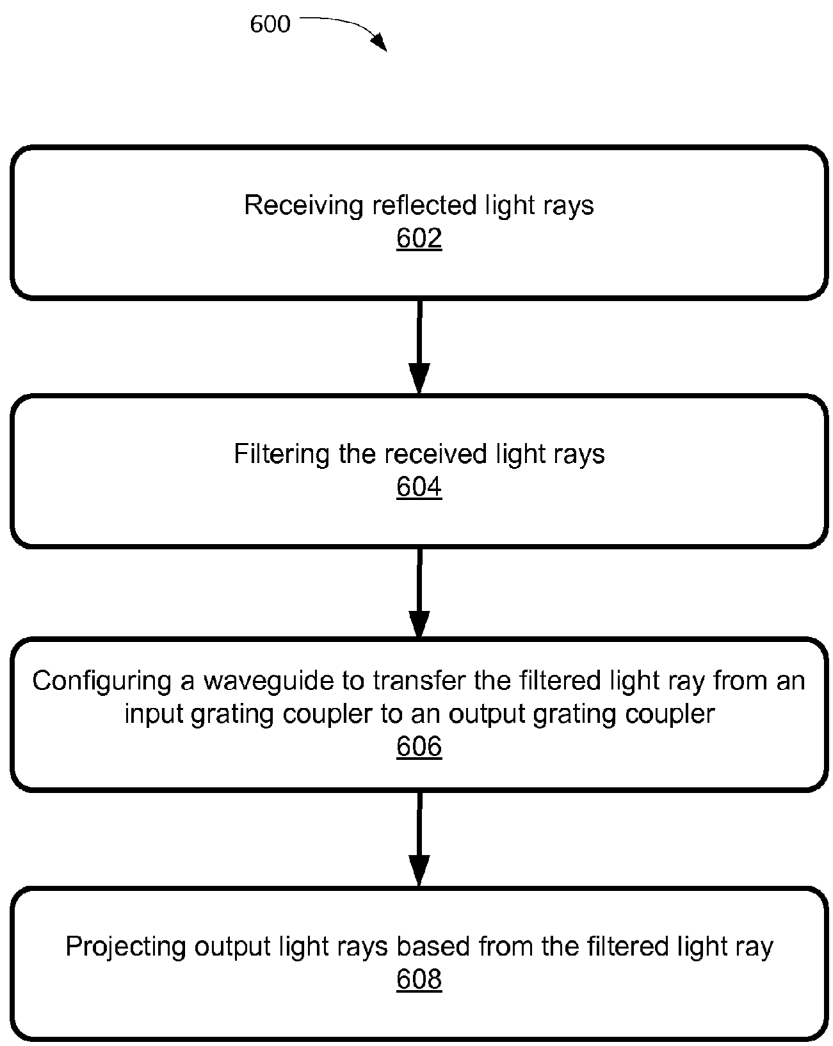

600
Receiving reflected light rays
602
Filtering the received light rays
604
Configuring a waveguide to transfer the filtered light ray from an input grating coupler to an output grating coupler
606
Projecting output light rays based from the filtered light ray
608

FIG. 6

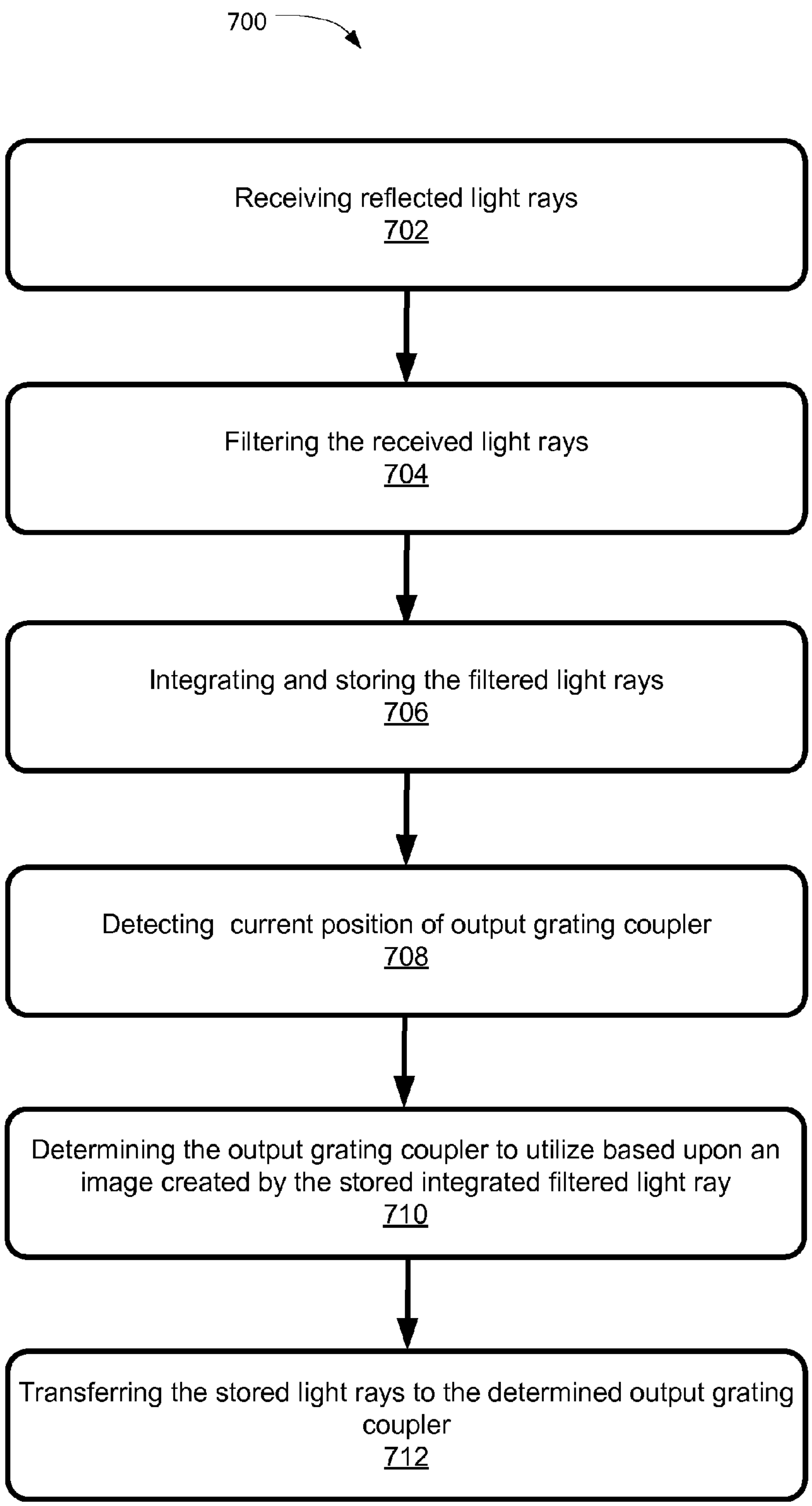

700
Receiving reflected light rays
702
Filtering the received light rays
704
Integrating and storing the filtered light rays
706
Detecting current position of output grating coupler
708
Determining the output grating coupler to utilize based upon an image created by the stored integrated filtered light ray
710
Transferring the stored light rays to the determined output grating coupler
712

FIG. 7

CLOAKING SYSTEM WITH WAVEGUIDES

BACKGROUND

There are several methods of concealment. For example, the concealment or camouflaging is achieved by covering an object with a clothing material that contains similar patterns and designs of a surrounding area where the object is located. In this example, the clothing material resembles the environment to avoid visualization of the object to be concealed. However, this type of concealment is unreliable since the surrounding area tends to change at any given time. In other words, when the object is moving from one place to another, this type of concealment is not effective unless it adapts to the dynamic nature of the surrounding area where the object is currently located.

In military and police surveillance, concealment is very important. Concealment of structures that are bulky and with inconsistent shapes can be expensive and hard since the surrounding area may change from time to time. For example, concealment of the structures may include several types of camouflaging if the structures are movable and generally used as a mobile structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an example scenario that shows an example situation of utilizing a cloaking device that is embedded with waveguides.

FIG. **2** illustrates an example scenario that shows an example situation of utilizing a cloaking device suit that is embedded with waveguides.

FIG. **3** illustrates an example image projector that shows an example fabric of a cloaking device.

FIG. **4** illustrates an example image projector that shows an example bidirectional fabric of a cloaking device.

FIGS. **5***a* and **5***b* illustrate an example implementation of a cloaking device suit.

FIG. **6** illustrates an example flowchart of an example method of implementing a passive cloaking device with embedded microwaves.

FIG. **7** illustrates an example flowchart of an example method of implementing an active cloaking device suit with embedded microwaves.

DETAILED DESCRIPTION

Described herein is a technology for passive or active cloaking devices (i.e., camouflage) that allow an object or person to blend into its surroundings. More particularly, a method of projecting a scene image from one side to opposite side of the passive or active cloaking device is described.

For example, a passive cloaking device is made up of at least one input and at least one output grating coupler that are respectively coupled to both ends of a waveguide. In this example, the scene image from one side of the passive cloaking device directs light rays that are received by the input grating couplers. The received light rays are filtered and directed from the input grating coupler to the output grating coupler through the waveguide. Thereafter, the output grating coupler is configured to provide output light rays to reproduce the scene image that reflected the light rays at the input grating coupler side.

In another example, an active cloaking device suit utilizes a cloaking device integrator to receive the filtered light rays from the input grating coupler. In this example, the cloaking device integrator integrates and stores the filtered light rays to

a memory. The stored integrated filtered light rays may actually include an initial image that will be projected at the output grating couplers. For example, the cloaking device integrator is configured to detect current position of the output grating couplers and thereafter determines the output grating couplers to be utilized in projecting the initial image. In this example, the stored integrated filtered light rays are transferred to the determined output grating couplers to provide output light rays. The output light rays may project the initial image that is created by the stored integrated filtered light rays. Consequently, the active cloaking device suit provides invisibility to a user.

FIG. **1** illustrates a scenario **100** that shows an example situation of utilizing a cloaking device that is embedded with waveguides. Scenario **100** shows a human eye **102** that is located at left side **104** of an antenna **106**, a tree **108** at right side **110** of the antenna **106**, and a cloaking device **112**.

As an example of present implementation herein, a complete view of the tree **108** is not possible when viewed at the left side **104** of the antenna **106**; however, with the cloaking device **112** that blankets the antenna **106**, the complete view of the tree **108** is now visible to the human eye **102**. In other words, an image of the tree **108** is projected by the cloaking device **112** from the right side **110** to the left side **104** such that, the human eye **102** will be able to view completely the tree **108** rather than the antenna **106**. Consequently, the antenna **106** becomes "invisible" to the human eye **102**, since the area behind the object (i.e., antenna **106**) is projected to the human eye **102** by the cloaking device **112**.

As an example of present implementation herein, the cloaking device **112** may be a passive cloaking device that is made up of input/output grating couplers (not shown) that are coupled to both ends of waveguides (not shown) to project the scene image of the tree **108** from right side **110** to the left side **104** of the antenna **106**. For example, the input grating couplers may be configured to receive reflected lights (not shown) from the tree **108**. In this example, the input grating couplers are coupled to the waveguides that are wrapped around the cloaking device **112** from the right side **110** to the left side **104**. In other words, the input grating coupler and the output grating coupler are coaxial with one another with the waveguide located in between them to transfer the received reflected lights. To this end, a field of view for the human eye **102** contains the image of the tree **108** rather than the antenna **106**.

In another implementation, the cloaking device **112** is an active device. For example, the input/output couplers and the waveguides are configured to transfer the received reflected lights rays from the right side **110** towards the location of the human eye **102** by amplifying the light rays. In this example, a power source (e.g., batteries) may be utilized to provide amplification of the received reflected lights.

FIG. **2** illustrates a scenario **200** that shows another example situation of utilizing the cloaking device that is embedded with waveguides. Scenario **200** shows a hunter **202** aiming a rifle **204**, a cloaking device suit **206**, and bushes **208**. Furthermore, FIG. **2**(*a*) shows the hunter **202** without the cloaking device suit **206** while FIG. **2**(*b*) shows the hunter **202** wearing the cloaking device suit **206** to appear invisible in the bushes **208**.

As an example of present implementation herein, FIG. **2**(*a*) shows the hunter **202** to be completely visible while aiming his rifle **204** behind the bushes **208**. On the other hand, when the hunter **202** is wearing the cloaking device suit **206** as shown in FIG. **2**(*b*), the visibility is limited to his head, shoes, palms and fingers, or other parts of his body that were not covered by the cloaking device suit **206**.

For example, FIG. **2***b* shows the hunter **202** in kneeling position while wearing the cloaking device suit **206**. In this example, light reflections from the bushes **208** behind the hunter **202** are projected to his front. In other words, rather than seeing the body of the hunter **202**, the cloaking device suit **206** projects portions of the bushes **208** to project partial invisibility of the hunter **202**. For example, as shown in FIG. **2**(*b*), the visible objects are limited to shoes, head, rifle **204**, and hands of the hunter **202**. The body parts covered by the cloaking device suit **206** are not visible.

Similar to FIG. **1**, the cloaking device suit **206** may be an active or passive cloaking device suit **206**. It is to be understood that an article of clothing can be an embodiment of the cloaking device that is described if the fabric of the clothing has the described structure (i.e., waveguides, couplers, etc.) integrated into the clothing/fabric.

FIG. **3** illustrates an example image projector **300** that shows an example fabric of the cloaking devices in FIGS. **1** and **2**. FIG. **3** shows the tree **108** that reflects light rays **302**, an input grating coupler **304**, waveguide **306**, a cladding material **308**, filtered light ray **310**, output grating coupler **312**, output light rays **314**, and the human eye **102**. Furthermore, FIG. **3** shows a cross-sectional **316** of the image projector **300** to particularly show the cladding material **308** and opening **318-2** of the input grating coupler **304** as opposed to opening **318-4** of the output grating coupler **312**.

As an example of present implementation herein, the input grating coupler **304** may contain a wide aperture of about sixty microns to receive the light rays **302** from the tree **108**. The light rays **302** are reflections from a portion of the tree **108**. For example, the light rays **302** are reflections from a branch of the tree **108**. In this example, a multiple set of light rays **302** are reflected from the whole tree and the multiple set of light rays **302** are correspondingly received by waveguides of the cloaking device in FIG. **3**.

In an implementation, the received light rays **302** are filtered through the opening **318-2** of the input grating **304**. For example, the opening **318-2** of the input grating **304** is configured to provide the filtered light ray **310** that will reflect and be directed through the waveguide **306** due to total internal reflection. In this example, the total internal reflection denotes the filtered light ray **310** to enter and strike a medium boundary at an angle larger than a particular critical angle—with respect to a normal of a surface in the medium boundary—in order to be reflected through the waveguide **306**.

As an example of present implementation herein, the filtered light ray **310** initially starts with an incident angle that is configured to create the total internal reflection in the waveguide **306**. The total internal reflection creates the reflection throughout the waveguide **306** with minimal losses. For example, the filtered light ray **310** will be reflected continually until it exits the output grating coupler **312**. In this example, the opening **318-4** of the output grating coupler **312** is configured to provide the output light rays **314** to project an image of the received light rays **302**.

As an example of present implementation herein, the cladding material **308** may contain at least one layer of materials of lower refractive index that is in intimate contact with the waveguide **306** of higher refractive index. The higher refractive index in the waveguide **306** is utilized for the purpose of allowing the filtered light ray **310** to travel with minimal losses through the waveguide **306**. For example, the lower refractive index cladding material **308** is configured to cause the filtered light ray **310** to be confined to the waveguide **306** due to total internal reflection at the medium boundary between the cladding material **308** and the waveguide **306**. In this example, the waveguide **306** is configured to include a size (e.g., forty by forty microns) that will reflect the filtered light ray **310** from the input grating coupler **304** to the output grating coupler **312**.

In an implementation, multiple image projectors **300** are configured to project the image of the whole tree (i.e., tree **108**) from one side (e.g., right side **110**) of the cloak device **112** to the other side (e.g. left side **104**) as shown in FIG. **1**.

FIG. **4** illustrates an image projector **400** that shows an example bidirectional fabric of the cloaking devices in FIGS. **1** and **2**. Image projector **400** shows the waveguide **306-4** that projects the light rays **302** from right side to left side, and another waveguide **306-4** that projects light rays **402** from the left side to the right side. However with optic waveguides and grating couplers (which are both passive) light can travel in both directions simultaneously (there is reciprocity). Therefore in certain implementations, bidirectional image routing may be done with one grating coupler on each end of one waveguide and direct images from each side to each other side over the same waveguide.

As an example of present implementations herein, the operations for projecting the received light rays **302** as discussed in FIG. **3** is similarly applied in FIG. **4**; however, this operation is applied in two opposite directions for two different set of waveguides **306**. For example, adjacent to the output grating coupler **312-2** is a separate input grating coupler **304-4** that receives the light rays **402**. In this example, the light rays **402** may include reflected light rays from an object **404** that may be different from the tree **108**, which reflects the light rays **302** at the other end. The light rays **402** are received by the input grating coupler **304-4** and filtered to provide the filtered light ray **310-4**. Similar to the waveguide **306-2**, the waveguide **306-4** is configured to transfer the filtered light ray **310-4** from the input grating coupler **304-4** to the output grating coupler **312-4** due to presence of the total internal reflection. In this case, output light rays **406** may project the object **404** that reflects the light rays **402**.

FIGS. **5**(*a*) and **5**(*b*) illustrate an example implementation of cloaking device suit **206**. FIG. **5***a* shows the hunter **202** with the cloaking device suit **206** in a creased formation. For example, when the hunter **202** is in a kneeling position, the cloaking device suit **206** will have creases such as, folds along the knee, hands, and legs of the hunter **202**. In other words, the input grating coupler **304** is not concentric with the output grating coupler **312**. Consequently, utilizing a passive cloaking device suit **206** may provide an incomplete resemblance of an image (e.g., bushes **208**) to provide invisibility of the hunter **202**. This is due to the non-concentricity where the output light rays **314** are projected in a different direction that may be out of phase with the other output light rays **314**.

As an example of present implementations herein, FIG. **5**(*b*) shows an example implementation of active cloaking device system. For example, a cloaking device integrator **500** is utilized to control projection of images from the input grating couplers **304** to the output grating couplers **312** to create invisibility of the hunter **202** such as, behind the bushes **208** in FIG. **2**. In this example, the cloaking device integrator **500** contains a system on chip (SOC) microcontroller **502**, a crease detector **504**, image projector **506**, and memory **508**.

In an implementation, the filtered light rays **310** from the input grating couplers **304** are received and integrated by the image integrator and projector **508** to form an initial image of a reflecting object (e.g., bushes **208**). In this implementation, the initial image or the filtered light rays **310** are stored in the memory **508**. Furthermore, the image integrator and projector **508** is configured to supply to the memory **508** the particular input grating coupler **304** that is a source for the filtered light ray **310**.

In an implementation, the SOC microcontroller **502** is configured to control operation of the cloaking device integrator **500**. For example, the SOC microcontroller **502** is configured to determine the current crease (i.e., current fold) of the cloaking device suit **206** through the crease detector **504**. In this example, the SOC microcontroller **502** may detect bending and twisting of the cloaking device suit **206** through the crease detector **504** and thereafter determines whether the hunter **202** is in the kneeling position, sitting position, or the like. Furthermore, the SOC microcontroller **502** utilizes the crease detector **504** to detect current positions of the output grating couplers **312** in order to determine the output grating couplers **312** to be used in projecting the initial image that is created by the stored integrated filtered light rays **310**.

As an example of present implementations herein, the SOC microcontroller **502** is configured to utilize the output grating couplers **312** that may provide resemblance to the stored initial image of the bushes **208**. For example, based from the determined current crease of the cloaking device suit **206**, the SOC microcontroller **502** is configured to determine which output grating coupler **312** are utilized to project output light rays that resembles the stored initial image of the bushes **208**. In this example, the image integrator and projector **506** is configured to transfer the stored integrated filtered light rays **310** to the determined output grating couplers **312**.

As an example of present implementations herein, the waveguides **306** are utilized in coupling the input grating couplers **304** and the output grating couplers **312** to the cloaking device integrator **500**.

FIG. **6** shows an example process flowchart **600** illustrating an example method of implementing a passive cloaking device with embedded optical waves/photons. The order in which the method is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the method, or alternate method. Additionally, individual blocks may be deleted from the method without departing from the spirit and scope of the subject matter described herein. Furthermore, the method may be implemented in any suitable hardware, software, firmware, or a combination thereof, without departing from the scope of the invention.

At block **602**, receiving reflected light rays is performed. For example, an object (e.g., tree **108**) reflects light rays (e.g., light rays **302**) that may be received by an input grating coupler (e.g., input grating coupler **304**).

At block **604**, filtering the received light rays to create a filtered light ray is performed. For example, an opening (e.g., opening **316**) of the input grating coupler **304** is configured to filter the received light rays **302**. In this example, the opening **316** provides a filtered light ray (e.g., filtered light ray **310**) with an incident angle that produces a total internal reflection in a waveguide (e.g., waveguide **306**). The total internal reflection is created due to a cladding material (e.g., cladding material **308**) that envelopes the waveguide **306**. For example, the cladding material **308** contains a lesser refractive index as compared to the waveguide **306**. In this example, the difference in the refractive index coupled with the configured opening **316** at the input grating coupler **304** may provide the total internal reflection.

At block **606** configuring the waveguide to transfer the filtered light ray from the input grating coupler to output grating coupler is performed. For example, the filtered light ray is reflected with minimum losses from the input grating coupler **304** to the waveguide **306**. In this example, the dimensions of the waveguide **306** are configured to provide the total internal reflection in order to contain the filtered light ray **310** within the waveguide **306**. In other words, the dimensions of the waveguide **306** (e.g., forty by forty microns) are configured to avoid refraction of the filtered light ray **310** to the cladding material **308**.

At block **608**, projecting output light rays based from the filtered light ray is performed. For example, the filtered light ray **310** is directed all the way from the input grating coupler **304** to an output grating coupler (e.g., output grating coupler **312**). In this example, another opening (e.g., opening **318-4**) of the output grating coupler **312** is configured to provide an output light ray (e.g., output light ray **314**) based from the filtered light ray **310**. In other words, the output light rays **314** project an image representation of the received light rays **302** at the input grating coupler **304**.

In an implementation, construction configuration of the input grating coupler **304** is exactly in an opposite direction as against the output grating coupler **312**. For example, the input grating coupler **304** is receiving the light rays **302** at right side (e.g., right side **110**) while the output grating coupler **312** is facing the direction of a viewer (e.g., human eye **102**) at the other side (e.g., left side **104**). In this example, the input grating coupler **304** and the output grating coupler **312** are concentric with one another.

Furthermore, multiple sets of image projector systems (e.g., image projector **300**) that contain the input grating coupler **304**, waveguides **306**, and the output grating are configured to project whole image of the tree **108**. For example, a cloaking device (e.g., cloaking device **112**) is made up of multiple input grating couplers **304** to receive the light rays **302** at the right side **110** and project the light rays **302** to the left side **104** to provide resemblance of the whole image of the tree **108**.

FIG. **7** shows an example process flowchart **700** illustrating an example method of implementing an active cloaking device suit with embedded optical waves/photons. The order in which the method is described is not intended to be construed as a limitation, and any number of the described method blocks can be combined in any order to implement the method, or alternate method. Additionally, individual blocks may be deleted from the method without departing from the spirit and scope of the subject matter described herein. Furthermore, the method may be implemented in any suitable hardware, software, firmware, or a combination thereof, without departing from the scope of the invention.

At block **702**, receiving reflected light rays is performed. For example, an object (e.g., bushes **208**) reflects light rays (e.g., light rays **302**) that may be received by the input grating coupler **304**.

At block **704**, filtering the received light rays to create a filtered light ray is performed. For example, an opening (e.g., opening **316**) of the input grating coupler **304** is configured to filter the received light rays **302** (that are reflected by the bushes **208**). In this example, the opening **316** provides a filtered light ray (e.g., filtered light ray **310**) with an incident angle that produces a total internal reflection in a waveguide (e.g., waveguide **306**). The total internal reflection is created due to a cladding material (e.g., cladding material **308**) that envelopes the waveguide **306**. For example, the cladding material **308** contains a lesser refractive index as compared to the waveguide **306**. In this example, the difference in the refractive index in addition to the configuration of the opening **316** at the input grating coupler **304** may provide the total internal reflection.

At block **706**, integrating and storing the filtered light rays is performed. For example, an SOC microcontroller (e.g., SOC microcontroller **502**) is configured to integrate all of the filtered light rays **310** at a particular time instant before storing the integrated filtered light rays **310** to a memory. In this example, the integrated filtered light rays **310** may themselves provide a projected image of the filtered light rays **310** at the particular time instant. Furthermore, the SOC microcontroller is configured to detect a particular input grating coupler source of a particular filtered light ray **310**.

At block **708**, detecting current position of output grating couplers at opposite sides of the cloaking device suit is performed. For example, the SOC microcontroller is configured to determine the current crease (i.e., current fold) of the cloaking device suit **206** by detecting bending and twisting of the cloaking device suit **206** through a crease detector (e.g., crease detector **504**). In this example, the crease detector **504** is utilized to detect a current posture (e.g., kneeling position, sitting position, etc.) of a user (e.g., hunter **202**). Furthermore, the crease detector **504** is utilized to determine current position of the output grating couplers **312** and relays this information to the SOC microcontroller **502**.

At block **710** transferring the stored light rays **310** to the output grating coupler is performed. For example, after determining the output grating couplers **312** to utilize in projecting the image created by the stored integrated filtered light rays **310**, the SOC microcontroller **502** is configured to direct an image integrator and projector component (e.g., image integrator and projector **506**) to transfer the stored integrated filtered light rays **310** to the determined output grating couplers **312**.

What is claimed is:

1. A cloaking device comprising:

an input grating coupler that is configured to receive and filter light rays, the input grating coupler is located at one side of the cloaking device;

a waveguide coupled to the input grating coupler, the waveguide is configured as a fabric that is wrapped around and ends at opposite side of the cloaking device, wherein the waveguide is configured to direct the filtered light rays;

an output grating coupler coupled to the waveguide at the opposite side of the cloaking device, the output grating coupler is configured to be concentric with the input grating coupler, the output grating coupler is configured to provide output light rays; and

a crease detector that is configured to detect current position of an output grating coupler.

2. The cloaking device as recited in claim **1**, wherein the cloaking device is a passive cloaking device that is utilized to blanket an object, wherein an image behind the passive cloaking device reflects the light rays and the output light rays reproduce the image in front of the cloaking device.

3. The cloaking device as recited in claim **1**, wherein the input grating coupler is configured to include an opening that filters the light rays, the opening is configured to create total internal reflection of the filtered light ray.

4. The cloaking device as recited in claim **1**, wherein the waveguide is wrapped with a cladding material that includes a lesser refractive index, wherein a boundary between the waveguide and the cladding material reflects the filtered light rays within the waveguide that includes a higher refractive index.

5. The cloaking device as recited in claim **1**, wherein the output grating coupler is configured to include an opening to provide the output light rays.

6. The cloaking device as recited in claim **1**, wherein the waveguide is bidirectional.

7. Clothing comprising the cloaking device as recited in claim **1**.

8. The cloaking device system as recited in claim **1**, wherein the crease detector is further configured to determine whether the fabric of the waveguide is bent or twisted.

9. A cloaking device system comprising:

an input grating coupler that is configured to receive and filter light rays;

a cloaking device integrator coupled to the input grating coupler, the cloaking device integrator comprising:

an image integrator and projector that receives and integrates the filtered light rays;

a memory that is configured to store the integrated filtered light rays;

a crease detector that is configured to detect current position of an output grating coupler;

a system on chip (SOC) microprocessor unit that is configured to determine which output grating coupler to utilize based upon the detected current position, wherein the image integrator and projector transfers the stored integrated filtered light rays to the determined output grating coupler;

the output grating coupler coupled to the cloaking device integrator, the output grating coupler is configured to provide output light rays.

10. The cloaking device system as recited in claim **9**, wherein the input grating couplers are located at one side of a cloaking device while the output grating couplers are located at opposite side of the cloaking device, or vice-versa.

11. The cloaking device system as recited in claim **9**, wherein the output grating coupler includes an opening that is configured to provide the output light rays.

12. The cloaking device system as recited in claim **9**, wherein the SOC microcontroller is configured to determine which output grating coupler to utilize based upon an image created by the stored integrated filtered light rays.

13. The cloaking device system as recited in claim **9** further comprising a waveguide to couple the input grating coupler to the cloaking device integrator, and a second waveguide that couples the cloaking device integrator to the output grating coupler.

14. The cloaking device system of claim **13** wherein the waveguides are bidirectional.

15. The cloaking device system as recited in claim **9** further comprising a cladding material that includes a lesser refractive index, wherein a boundary between a waveguide and the cladding material reflects the filtered light rays within the waveguide that includes a higher refractive index.

16. The cloaking device system as recited in claim **9**, wherein the input grating coupler is configured to include an opening that filters the light rays, the opening is configured to create total internal reflection of the filtered light ray.

17. The cloaking device system as recited in claim **9**, wherein the crease detector is further configured to determine whether the fabric of the waveguide is bent or twisted.

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